# VERTICAL DOOR FAN SHUTTER

## TECHNICAL FIELD

The present invention relates generally to the field of fan shutters and, more particularly, to fan shutters having a vertical orientation and which prevent air flow through a fan when the fan is off.

## BACKGROUND ART

Buildings often have ventilation systems for the exchange of air between the building and the outside. These ventilation systems are usually complex and are connected to the air handling or heating and air conditioning system of the building. Other ventilation systems are less complex and are merely for exhausting stale air from the building, for introducing fresh air into the building, or for basic temperature regulation by exhausting hot or cold air from the building as necessary.

Various shutters, dampers, and closure panels for fans are known to regulate the exchange of air between the inside and outside of a building. For example, a series of horizontal louvers can be constructed to remain closed when the fan is off, but are pulled open by the airflow when the fan is on. A disadvantage of horizontal louvers is that dust builds up on the louvers, impeding their operation and airflow. Shutters constructed like a window shade roll down when the fan is off and roll up when the fan is on. A disadvantage of rolling shutters is that there are many mechanical and electrical parts that can fail or are difficult to maintain.

The general use of automatically opening and/or closing louvers, vents, and doors in connection with fans or other forced air systems is well known, including the use of the weight of the door alone, or the use of a counter weight to keep the door open or closed, or the use of string and pulley systems.

US Patent No. 6533656 to Hertel discloses a counterweighted cover for an air handling system duct. This is a horizontal closure to fit over an overhead or surface mounted duct vent. Forced air opens the cover, and when the forced air stops, the counterweight pivots the cover closed. US Patent No. 6203423 to Craw discloses a typical structure for a vertical damper flap. This is a gravity driven flap that is opened by forced air and closes by gravity when the forced air flow stops. US Patent No.

6183359 to Klein discloses a typical structure for a horizontal register flap. This is a gravity driven flap that is opened by forced air and closes by gravity when the forced air flow stops. US Patent No. 6183359 to Klein discloses a typical structure for a horizontal register flap. This is a gravity driven flap that is opened by forced air and closes by gravity when the forced air flow stops.

US Patent No. 6061968 to Zimmerman discloses a hinged door assembly comprising a weight to keep the door opened and a string/pulley/motor system to close the door. When it is desired to open the door, the motor unwinds the string and the weight, and the weight of the door opens the door. To close the door, the motor is reversed, winding the string. US Patent No. 5921862 to Ucciardi discloses a horizontally mounted door flap for use on the discharge opening of a fan. The forced air from the fan forces the door open and when the forced air flow stops, the weight of the door causes the door to close by gravity. The door has a counterweight to make it easier for the door to remain open.

US Patent No. 5567114 to Wallace discloses a typical structure for a counterweighted door for closing a downwardly oriented fan outlet. This is a gravity driven flap that is opened by forced air and closes by the weight of the counterweight when the forced air flow stops. US Patent No. 5195927 to Raisanen discloses an intake vent for a barn. The described advantages of this vent include its ability to be mounted on either side of a wall and a counterweight for keeping the vent closed. US Patent No. 4850265 to Raisanen discloses a cupola mounted air vent for a building having a structure for baffling rain. This device also has counterweights for keeping the vent closed.

US Patent No. 4047328 to Kehl discloses a greenhouse structure including a cooling system comprising a horizontally pivotable vent flap held closed by a string/pulley and counterweight. The vent flap is hinged at its bottom to the greenhouse wall and opens from the top when the air pressure in the greenhouse is greater than outside. The string is attached to the top of the vent and is weighted to keep the vent closed. US Patent No. 3631790 to Olsen discloses an automatically closing louver. The louver has a horizontally mounted hinge and sits downstream of the air flow. The air flow opens the louver and when the air flow stops, the weight of the louver causes it to close. US Patent No. 3363531 to Kohlmeyer discloses a vent for an animal house comprising a closure flap operated by a string/pulley device. Pulling the string causes the flap to rotate open or closed.

US Patent No. 2823600 to Cole discloses a vent for use in an air conditioning system. The system comprises dampers that open and close depending on whether a fan is on or off. When the fan is on, the pull of the air opens the dampers. US Patent No. 2502736 to Marcoe discloses a horizontally hinged intake vent with a counterweight damper plate. Air pressure causes the vent to open and when the air pressure equilibrates, the counterweight causes the vent to close. US Patent No. 218596 to Taber discloses a horizontally hinged damper that opens inwardly to a duct when the air pressure within the duct is lower than the air pressure outside of the duct, and is for use in a stovepipe. A counterweight closes the vent when the air pressure equilibrates.

Animal houses, such as chicken houses must have exhaust ventilation. Large fans typically are mounted on one end of the chicken house to pull air out of the chicken house. When the fans are on, there must be as unimpeded an air flow through the fan as possible to allow for both adequate ventilation and fan efficiency. When the fans are off, it is preferable to prevent air from escaping from the chicken house and/or air entering the chicken house through the fan box. This is especially true in the summer and winter to prevent the chicken houses from becoming too hot (summer) or too cold (winter) and to prevent excessive cooling or heating costs. Fan shutters can be valuable in lowering heating and cooling costs and in providing a better environment for the inhabitants of the building.

Notwithstanding the use of known ventilation systems, there is need for a mechanically simple and relatively low cost fan shutter that does not require frequent maintenance and/or repair.

## DISCLOSURE OF THE INVENTION

The present invention has a housing that fits over a fan on the interior of a building. The back of the housing faces the fan. The front or inlet of the housing has two vertical doors that swing horizontally and that open and close when the fan is turned on and off, respectively. The housing uses one or more mechanisms to keep the doors shut when the fan is off. In a first embodiment the top of the housing extends farther out than the bottom of the housing so that the doors are not quite vertical, and the tops of the doors are biased outward relative to the fan. Thus, gravity makes the doors swing shut. When the fan is on, the vacuum caused by the fan is sufficient to

open the doors. In a second embodiment a counter weight is attached by a wire to each door. The counter weight biases the doors toward a closed position. In a third embodiment a spring is built into the hinge of each door to bias the doors toward a closed position. A combination of these mechanisms can be used to ensure the doors remain closed when the fan is off. The housing can have a rectangular or triangular shape. Alternatively, the housing can have a tubular shape with a bell mouth on the inlet side.

An advantage of the present invention is a fan shutter that is simple in construction, durable, and easy to construct.

Another advantage is a fan shutter that requires little maintenance.

Another advantage is a fan shutter that is inexpensive.

Another advantage is a fan shutter that prevents air flow across the fan when the fan is off.

Another advantage is a fan shutter that improves the performance and efficiency of an air moving device such as, for example, a fan.

Another advantage is a fan shutter that improves breeding productivity in a poultry house.

## BRIEF DESCRIPTION OF THE DRAWINGS

**Fig. 1** shows a front view of the fan shutter of the present invention wherein the doors are mounted slightly less than vertical, using gravity for door closure.

**Fig. 2** is a side view of the fan shutter of **Fig. 1** showing the front end of the housing tilting downward.

**Fig. 3** is a side view of an embodiment in which the entire housing tilts downward.

**Fig. 4** is a side view of the fan shutter wherein the doors are mounted vertical, using springs or counterweights for door closure.

**Fig. 5** is a front view of the fan shutter with a tubular housing having a bell mouth on the intake side of the housing, the doors being in a closed position.

**Fig. 6** shows the fan shutter of **Fig. 5** with doors in an open position.

## BEST MODE FOR CARRYING OUT THE INVENTION

While the following description details the preferred embodiments of the present invention, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of the parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced in various ways.

**Fig. 1** shows a front view of the fan shutter **10** of the present invention. Fan shutter **10** has a housing **11** that covers exhaust fan **24** and that supports doors **17**. Housing **11** has a top **12**, a bottom **13** and sides **14**. The front end (inlet side) **25** is, preferably, triangular in shape with a center post **16**. Doors **17** are mounted pivotally to center post **16** with hinges **18**. Doors **17** are biased to close the open front end of housing **11** when the fan is off. Doors **17** are biased in a closed position, preferably, by the force of gravity. This is accomplished by mounting housing **11** vertically, but having the front end **25** tilt downward slightly from vertical about 1 to 20 degrees. Alternatively, the housing can be mounted tilting downward slightly from vertical about 1 to 20 degrees, while the front end **15** of the housing remains vertical. These features are shown in more detail in **Figs. 2** and **3**. Because the doors are mounted in a vertical orientation and rotate horizontally, they will close the openings of the front end of shutter **11** when the fan is off. Doors **17** contact front edges **15** of housing **11** upon complete closure of the front end of housing **11**. Front edges **15** prevent doors **17** from swinging outside housing **11**. Back end **26** of housing **11** is attached adjacent to fan **24** using tabs or flanges **19**. Doors **17** can also be biased using counter weights **21** with cables **22**, or with springs in the hinges **18**. Gravity, counterweights, or springs can be used separately or in combinations to bias door **17** in a closed position. When exhaust fan **24** is turned on it creates sufficient vacuum to open the doors, even though the doors are biased towards a closed position. The use of vertical doors instead of horizontal louvers provides improved air flow and less stress on the fan. In addition, vertical doors provide less surface openings for the accumulation of dirt, compared to horizontal louvers.

**Fig. 2** shows a side view of the fan shutter **10** shown in **Fig. 1**. The top **12** of housing **11** extends further from the wall **23** than the bottom **13**. Thus, front end **12** and center post **16** tilt downward, biasing the doors **17** to close by the force of gravity when fan **24** is not operating. **Fig. 3** shows an alternate construction of housing **11**,

wherein the entire housing **11** tilts downward but front end **25** remains vertical. Doors **17** are also biased in the closed position by the force of gravity with this construction.

**Fig. 4** shows a side view of the fan shutter **10** of **Fig. 1**, except that neither the housing **11** or front end **25** tilt downward. The entire housing is mounted precisely vertical. In this embodiment doors **17** are not biased to close by the force of gravity. The doors can be biased with counterweights **21** or springs in hinges **18** or both.

**Fig. 5** illustrates an alternate embodiment of the present invention wherein the housing is round. Fan shutter **30** has a tubular housing **31**. The back end **36** of housing **31** fits over wall **35** in front exhaust fan **38**. Front end **37** (inlet) of housing **31** has a bell mouth **32**, and two vertical doors **33** which are hinged directly to front end **37** of housing **31** at hinge points **34**. The bell mouth **32** and tubular shaped housing **31** allow air to flow more smoothly and evenly without turbulence compared to rectangular units, improving the air flow and efficiency of exhaust fan **38**. The front end **37** of the housing **31** can be tilted as described in **Figs. 1-4**, so that doors **31** are biased in a closed position by gravity. Accordingly, the doors **33** will remain shut when exhaust fan **38** is off. When exhaust fan **38** is on, the vacuum created by exhaust fan **38** will open doors **33**. Hinging of doors **33** at hinge points **34** can be accomplished by pins or inserts on doors **33** extending into housing **31**. Thus, vertical doors **33** will pivot horizontally at hinge points **34**. Doors **33** can also be biased in a closed position by the use of springs at the hinge points **34**, or by counterweights, as described in **Figs. 1-4**. **Fig. 6** shows the fan shutter **30** of **Fig. 5** with doors **33** in an open position. A one piece, unified, damper fan combination can be constructed by having housing **31** and fan system **38** form a single unit.

The foregoing description has been limited to specific embodiments of this invention. It will be apparent, however, that variations and modifications may be made by those skilled in the art to the disclosed embodiments of the invention, with the attainment of some or all of its advantages and without departing from the spirit and scope of the present invention. For example, the fan shutter can have curved edges and corners for safety. Other pivot joints known in the art besides hinges can be used on the doors. In addition to the front edges of the housing, other door stop mechanisms known in the art can be used to prevent the doors from swinging outside the housing and to insure that the doors seal the front end of the housing. A spring device can be added in the center of the doors and counter levered over so that when the doors are open, while the fan is operating, they will not have any pressure against

them. Any type of suitable material can be used for the cable to connect the counterweight to the door, including string, twine, cable, chain, rope, and the like. The fan shutter can be built to any size to accommodate any size fan, and can be incorporated into the fan housing to form a single unitary housing for the fan, fan motor, shutter, and related parts. The shutter housing can be round, elliptical, square, or otherwise, and the bell mouth can be used with any shaped housing. The front end of the housing can be flat (coplanar with the fan) or round, instead of triangular. The front end of the housing can have one or a plurality of doors. The fan shutter of the present invention can be made from any suitable materials such as, for example, plastic, metal, wood, ceramics, fibers, glasses or a combination thereof.

It will be understood that various changes in the details, materials, and arrangements of the parts which have been described and illustrated above in order to explain the nature of this invention may be made by those skilled in the art without departing from the principle and scope of the invention as recited in the following claims.